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PERFORMANCE TESTS OF A TRION ELECTRIC AIR FILTER

by

Thomas W. Watson
and
Henry E. Robinson
Heating and Air Conditioning Section
Building Technology Division

to

Corps of Engineers, U. S. Army
Office of the District Engineer
Galveston, Texas

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1. INTRODUCTION

At the request of the Corps of Engineers, U. S. Army, Office of the District Engineer, Galveston District, Galveston, Texas (reference: letter dated August 27, File SWNVG), qualification tests were made to determine the performance of an "Electric Air Cleaner" manufactured by Trion, Incorporated, McKees Rocks, Pennsylvania.

The specification requirements of the Corps of Engineers were stated in the test request as follows: "The precipitators shall be of the proper type and size to clean the specified volume of air with an efficiency of not less than 90% by the U. S. Bureau of Standards Discoloration Method of Test and the resistance to air flow shall not exceed 0.20 " W. G. at 400 fpm face velocity."

2. DESCRIPTION OF THE AIR CLEANER

The cleaner was manufactured by Trion, Inc., of McKees Rocks, 1000 Island Avenue, Pennsylvania, and was of the electrostatic type. It was identified by nameplate as a Trion Electric Air Filter, Model 7-102-00 C Pack - serial 15317 115 volts 60 cycles.

The filter had actual outside dimensions of 24 x 22 1/4 and was 24 inches long (cross-sectional area of cell enclosure 3.71 ft^2). The upstream and downstream faces were flared out forming flanges 30 inches square so that the unit could be fitted into the test apparatus. The downstream face of the unit was housed to receive a nominal 20 x 20 x 1 or 2-inch after-filter. The housing opening had net dimensions of 18 5/16 x 18 9/16 inches. A 20 x 20 x 1 inch Research Products RP 9802 air filter was used as the after-filter in these tests.

The manufacturer furnished an adhesive designated as "Trion No. 368", and an applicator for oiling the collecting plates of the cell by spraying them from the upstream face. This was done in preparation for the tests by a representative of the manufacturer who was present during the tests. The power pack, connected to a 115 volt 60 cycle supply, was adjusted by the manufacturer's representative to a setting of 1.1 milliamperes on the power pack instrument; the ionizer and plate voltages that resulted were measured by means of a high resistance voltmeter which was compared with an accurate electrostatic voltmeter.

3. TEST METHOD AND PROCEDURE

Efficiency determinations were made by the NBS "Dust Spot Method" using outdoor air drawn through the laboratory without addition of other dust or contaminant. The test method is described in the paper "A Test Method for Air Filters" by R. S. Dill (ASHVE Transactions, Vol. 44, p. 379, 1938).

For these tests, the Trion unit was installed in the test duct and carefully sealed to prevent inleakage of air. The desired rate of air flow through the air cleaner was established, and samples of air were drawn from points one foot upstream and eight feet downstream of the air cleaner at equal rates and passed through equal areas of Whatman No. 41 filter paper (3/4-inch diameter spots). The downstream sample was drawn continuously during the test; the upstream sample was drawn intermittently in a number of short periods uniformly distributed over the duration of the test, aggregating one-tenth of the downstream sampling period. Under these conditions an efficiency of 90 percent would be indicated if the upstream and downstream dust-spots on the filter papers had the same opacity, as measured by the increase in the opacity of the filter paper determined by means of a photometer using transmitted light. If the opacities of the dust spots differ, an approximate value of the efficiency can be calculated by means of the formula

$$\text{Efficiency} = 100 - (10 \times \frac{O_2}{O_1}) \text{ percent,}$$

where O_2 and O_1 are the opacities of the dust spots downstream and upstream, respectively, and the factor 10 is determined by the ratio of the downstream and upstream sampling periods.

The unit as submitted had plastic-impregnated glass fiber sheets 22 x 18 x 1/8 inch in size between the collecting plates and the housing, at the top and at the bottom, to insulate the plates from the housing. The manufacturer requested that 22 x 17 3/4 x 1/8 inch sheets of glass be used in lieu of the glass fiber sheets. The glass sheets were substituted for the original sheets and used for all the tests given in this report.

4. TEST RESULTS

A summary of the test data obtained in tests conducted at rates of air flow corresponding to various face velocities (based on a face area of 3.71 ft^2) is given in the table below. It was observed that throughout these tests there was no instance of electrical sparking or flashing in the unit audible to the ear.

Table 1

Face Velocity fpm	Ionizer Voltage KV	Plate Voltage KV	Pressure Drop Inch W.G.	Duration of Test Minutes	Efficiency percent
225	15.1	7.3	0.097	180	95.1
333	15.2	7.4	.207	180	88.2
333	15.0	7.3	.207	180	88.1
400	15.0	7.3	.295	180	82.3
400	15.0	7.3	.295	200	83.3

5. REMARKS

The efficiency of the air cleaner in arresting the dust existent in the air drawn through the unit depended to a marked degree on the face velocity at which it was operated. In this connection, the manufacturer's representatives who attended the tests stated that they believed the procurement specification for the air cleaners at Galveston called for an operating face velocity of about 333 ft/min. rather than 400 ft/min.

The efficiencies are reported to three significant figures obtained from the test data. In reporting thus, however, it is considered desirable to point out that an uncertainty on the order of about 2 percent is possible in determining efficiencies, although the obvious differences appearing in the results are of lesser magnitude.

The pressure drop through the test unit was slightly greater, at 333 ft/min face velocity, than is believed to be required by the specification. The pressure drop through the unit with the after-filter removed was measured as 0.049 inch W. G. at about 359 ft/min face velocity. The greater part of the pressure drop of the complete unit was due therefore to the resistance of the after-filter. It is believed that substitution of an after-filter of lower resistance would not cause a significant change in the dust-arresting efficiency of the complete unit.

During the course of some of these tests, an operation involving the grading and sieving of coarse concrete aggregates was in progress in an area adjacent to the building in which the air cleaner tests were made. Some dust was released into the atmosphere by this process. However, since the general breeze direction was away from the air filter test building, and the air drawn into it for the tests entered through a large window on its remote side, it is believed the air filter tests were not significantly affected. The length of time required for obtaining suitable dust spots is further evidence that the air received at the test unit was not, in general, unusually contaminated.